

WE CLAIM:

1. A cartridge barrel for use in a medication pump comprising a cylindrical barrel wall comprising an open end and a closed end, wherein the closed end defines an orifice, the cartridge barrel further comprising a ridge defined on an interior face of the barrel wall, wherein the barrel wall is more opaque in the region extending from the ridge to the open end than in at least a portion of a remainder of the barrel wall.
2. The cartridge barrel of claim 1 wherein the region extending from the ridge to the open end comprises a textured surface.
3. The cartridge barrel of claim 1 further comprising a cylindrical end wall projecting from the closed end of the cylindrical barrel and surrounding the orifice, the end wall comprising an interior face, an exterior face, and axial guides on the exterior face.
4. The cartridge barrel of claim 3 wherein the end wall further comprises a thread structure on the interior face.
5. The cartridge barrel of claim 1 wherein an outer edge of the open end of the barrel wall defines a circle.
6. The cartridge of claim 5 wherein the open end of the barrel wall has an outer diameter that is substantially the same as an outer diameter of the remainder of the barrel wall.
7. The cartridge barrel of claim 3 further comprising a tip at the closed end within the end wall and in fluid communication with the orifice.

8. A medication pump comprising:
- a motor;
  - a first element configured to be rotated by the motor, the element having a front face;
  - a magnet attached to the front face of the first element, wherein a portion of the front face is not covered by the magnet; and
  - a magnetic field sensor spaced from an off-center location of the magnet.
9. The medication pump of claim 8, further comprising
- a cartridge chamber for receiving a medication cartridge, the chamber comprising a first open end for loading a medication chamber and a second end;
  - a drive rod comprising an interface end, wherein the drive rod extends into the cartridge chamber through the second end of the cartridge chamber so that the interface end of the drive rod is within the cartridge chamber, wherein the drive rod is configured to be axially moved by the motor.
10. The medication pump of claim 8 wherein the magnet includes a plurality of radially projecting structures that each cover a portion of the front face extending radially from near a center of the element to near an outer edge of the element.
11. The medication pump of claim 10 wherein the magnet includes four projecting structures.
12. The medication pump of claim 8 further comprising a motor gear that is configured to be rotated by the motor, wherein the motor gear is positioned to engage and rotate the first element.
13. The medication pump of claim 12 further comprising a drive gear that is positioned to be engaged and be rotated by the first element, wherein the drive gear is

operatively connected to the drive rod to cause axial movement of the drive rod when the drive gear is rotated.

14. The medication pump of claim 9 further comprising a drive gear that is positioned to be engaged and be rotated by the first element, wherein the drive gear is operatively connected to the drive rod to cause axial movement of the drive rod when the drive gear is rotated.

15. The medication pump of claim 9 wherein the magnetic field sensor is positioned on a circuit board that is spaced from the front face of the first element.

16. The medication pump of claim 15 wherein the first element comprises a first shaft extending axially toward the circuit board, the pump further comprising a first bushing comprising a first end, a second end, and a cavity in the first end, wherein the first bushing receives the first shaft in the cavity and the second end of the bushing contacts the circuit board.

17. The medication pump of claim 8 further comprising a processor operatively connected to the magnetic field sensor.

18. The medication pump of claim 17 wherein the processor is configured to activate an alarm based on input from the magnetic field sensor.

19. A method for detecting the rotation of a element in a medication pump, wherein the element includes a magnet attached to a front face of the element and a portion of the front face is not covered by the magnet, comprising measuring the magnetic field at a point near the front face.

20. The method of claim 19 further comprising recording the value of the magnetic field over time at the point near the front face.

21. The method of claim 20 wherein the element comprises a gear and the pump further comprises a drive rod operatively connected to the gear so that rotation of the gear causes axial movement of the drive rod, the method further comprising calculating the axial displacement of the drive rod based on the measurement of the changing magnetic field at the point near the front face.
22. The method of claim 19 wherein the pump further comprises a motor operatively connected to the element to rotate the element, further comprising activating an alarm if the motor is operating but the magnetic field is not changing over time.
23. A medication pump comprising:
- a cartridge chamber for receiving a medication cartridge, the chamber comprising a first open end for receiving the medication cartridge and a second end defining a drive rod opening;
  - a motor;
  - a drive rod comprising an interface end, wherein the interface end of the drive rod extends into the cartridge chamber through the drive rod opening, wherein the drive rod is configured to be axially moved by the motor; and
  - a light sensor positioned near the second end of the cartridge chamber configured to detect whether the medication cartridge is located within the cartridge chamber near the second end of the cartridge chamber.
24. The medication pump of claim 23, wherein interface end of the drive rod is configured to attach to a plunger within the medication cartridge.
25. The medication pump of claim 23, further comprising a processor operably connected to the light sensor.

26. The medication pump of claim 25, wherein the processor is configured to notify a user of whether or not the cartridge is within the cartridge chamber near the second end.
27. The medication pump of claim 23, wherein the light sensor comprises an emitter positioned at a first side of the cartridge chamber and a detector positioned at a second side of the cartridge chamber.
28. The medication pump of claim 27, wherein the emitter and detector are positioned at opposite ends of a chord through the cartridge chamber.
29. The medication pump of claim 27, wherein the emitter and detector are located outside of the cartridge chamber, wherein the detector is configured to detect light emitted by the emitter when there is no medication cartridge in the cartridge chamber.
30. The medication pump of claim 23, further comprising a medication cartridge comprising:
- a barrel wall comprising an open end and a closed end, wherein the closed end defines an orifice;
  - a ridge defined on an interior face of the barrel wall, wherein the barrel wall is more opaque in the region extending from the ridge to the open end than in at least a portion of a remainder of the barrel wall.
31. A medication pump system comprising:
- a medication cartridge comprising:
    - a cylindrical barrel wall comprising an open end and a closed end, wherein the closed end defines an orifice, and
    - a plunger slidably received within the barrel wall; and
  - a medication pump comprising:

a cartridge chamber for receiving the medication cartridge, the chamber comprising a first open end for receiving the medication cartridge and a second end defining a drive rod opening,

a motor,

a drive rod comprising an interface end, wherein the interface end of the drive rod extends into the cartridge chamber through the drive rod opening, wherein the drive rod is configured to be axially moved by the motor, wherein the interface end is configured to attach to the plunger, and

a light sensor positioned near the second end of the cartridge chamber configured to detect whether the medication cartridge is located within the cartridge chamber near the second end of the cartridge chamber.

32. The medication pump system of claim 31 wherein the cylindrical barrel wall comprises a ridge defined on an interior face of the barrel wall, wherein the barrel wall is more opaque in the region extending from the ridge to the open end than in at least a portion of the remainder of the barrel wall.

33. The medication pump system of claim 31, further comprising a processor operably connected to the light sensor and configured to notify a user of whether or not the cartridge is within the cartridge chamber near the second end.

34. The medication pump system of claim 31, wherein the light sensor comprises an emitter positioned at a first side of the cartridge chamber and a detector positioned at a second side of the cartridge chamber.

35. The medication pump system of claim 31, wherein the emitter and detector are positioned at opposite ends of a chord through the cartridge chamber, wherein the chord passes through the cylindrical barrel wall of the medication cartridge when the medication cartridge is located in the cartridge chamber.

36. The medication pump system of claim 35, wherein the chord does not pass through the drive rod.
37. The medication pump system of claim 34, wherein the emitter and detector are located outside of the cartridge chamber, wherein the detector is configured to detect light emitted by the emitter when there is no medication cartridge in the cartridge chamber.
38. A method of loading a medication cartridge into a first open end of a cartridge chamber of a medication pump, wherein the pump includes a drive rod extending into the cartridge chamber through a second end, comprising:
- detecting whether or not an old medication cartridge is present near the second end of the cartridge chamber;
  - if the old medication cartridge is not present, moving a drive rod to an initial loading position; and
  - prompting a user to insert a new medication cartridge into the cartridge chamber.
39. The method of claim 38, further comprising if the old medication cartridge is present near the second end of the chamber, prompting a user to remove the old medication cartridge;
40. The method of claim 38, further comprising:
- after prompting a user to insert a new medication cartridge, detecting whether or not the new medication cartridge is present near the second end of the cartridge chamber; and
  - if the medication cartridge is not present, retracting the drive rod until the cartridge is detected by a light sensor.
41. The method of claim 38, further comprising:

after prompting a user to insert a new medication cartridge, detecting whether or not the new medication cartridge is present near the second end of the cartridge chamber; and

if the medication cartridge is present, instructing the user to remove the cartridge and then fully extending the drive rod.

42. The method of claim 41, further comprising after fully extending the drive rod, prompting the user to attach a cartridge to the drive rod.

43. The method of claim 38 wherein the initial loading position is between a starting delivery point and an ending delivery point for a previous medication cartridge that was delivered using the pump.

44. The method of claim 43 wherein the initial loading position is approximately half-way or less between the starting delivery point and the ending delivery point for the previous medication cartridge that was delivered using the pump.

45. The method of claim 43 wherein the initial loading position is one-quarter of the distance between the starting delivery point and the ending delivery point for the previous medication cartridge that was delivered using the pump.

46. The method of claim 38 wherein the step of detecting whether or not a medication cartridge is present at the end of the cartridge chamber comprises receiving input from a light sensor positioned at the end of the cartridge chamber, wherein the light sensor is configured to detect whether the medication cartridge is located at the second end of the cartridge.

47. The method of claim 46, wherein the light sensor comprises an emitter positioned on a first side of the cartridge chamber and a detector positioned on a second side of the cartridge chamber.

48. The method of claim 47, wherein the emitter and detector are located outside of the cartridge chamber, wherein the detector is configured to detect light emitted by the emitter when there is no medication cartridge in the cartridge chamber.
49. The method of claim 38, further comprising the step of rotationally attaching a pump cap to the chamber opening after the user has inserted the cartridge.
50. The method of claim 49, wherein the pump cap comprises an interior surface comprising guides that engage axial guides at an end of the medication cartridge, wherein when the pump cap is rotated into engagement with the open end of the cartridge chamber, the cartridge is rotated in a direction to connect the cartridge to the drive rod.
51. The method of claim 38, further comprising:  
asking a user if a cartridge is being checked when a cartridge is removed;  
wherein if the user responds that the cartridge is being checked, the step of moving drive rod to the initial loading position comprises advancing the drive rod.
52. A medication pump comprising:  
a cartridge chamber for receiving a medication cartridge, the chamber comprising a first open end for receiving the medication cartridge and a second end defining a drive rod opening;  
a motor;  
a drive rod comprising an interface end, wherein the interface end of the drive rod extends into the cartridge chamber through the drive rod opening, wherein the drive rod is configured to be axially moved by the motor; and  
a light sensor including an emitter and a detector, the emitter and detector positioned at opposite ends of a chord through the cartridge chamber, wherein the chord

passes through a portion of the medication cartridge when the medication cartridge is in the cartridge chamber, wherein the chord does not pass through the drive rod.

53. The medication pump of claim 52 wherein the emitter and detector are located outside of the cartridge chamber.

54. The medication pump of claim 52, wherein interface end of the drive rod is configured to attach to a plunger within the medication cartridge.

55. The medication pump of claim 52, further comprising a processor operably connected to the light sensor, wherein the processor is configured to notify a user of whether or not the cartridge is within the cartridge chamber near the second end.

56. The medication pump of claim 52, further comprising a medication cartridge comprising:

a barrel wall comprising an open end and a closed end, wherein the closed end defines an orifice;

a ridge defined on an interior face of the barrel wall, wherein the barrel wall is more opaque in the region extending from the ridge to the open end than in at least a portion of a remainder of the barrel wall.

57. A medication pump comprising:

a motor;

a light sensor including an emitter and a detector configured to detect whether a medication cartridge is present in the pump;

a rotational sensor configured to detect whether an element attached to the motor is rotating; and

a processor operatively connected to the light sensor, rotational sensor and the motor, wherein the processor operates the motor based on input from the light sensor and rotational sensor.

58. The medication pump of claim 57 further comprising:  
a cartridge chamber for receiving a medication cartridge, the chamber comprising a first open end for receiving the medication cartridge and a second end defining a drive rod opening; and  
a drive rod comprising an interface end, wherein the interface end of the drive rod extends into the cartridge chamber through the drive rod opening, wherein the drive rod is configured to be axially moved by the motor.
59. The medication pump of claim 58 wherein the emitter and detector are positioned at opposite ends of a chord through the cartridge chamber, wherein the chord passes through a portion of the medication cartridge when the medication cartridge is in the cartridge chamber.
60. The medication pump of claim 57 wherein the motor is reversible.
61. The medication pump of claim 57 further comprising a pressure sensor configured to detect a high pressure condition in the medication cartridge.
62. The medication pump of claim 57 wherein the rotational sensor comprises:  
a first element configured to be rotated by the motor, the element having a front face;  
a magnet attached to the front face of the first element, wherein a portion of the front face is not covered by the magnet; and  
a magnetic field sensor spaced from an off-center location of the magnet.
63. The medication pump of claim 58 wherein the processor calculates the displacement of the drive rod during operation of the motor based on the rotations observed by the rotational sensor.